Thornton Tomasetti

Date:	March 30, 2021
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Project Name:	South Fork Shoshone River Bridge, South Fork County, WY
Project Number:	NN20078.00
Memo Subject:	Expert Report - Girder Deformation
Attachment(s):	

Mr. Hanlon,

Thornton Tomasetti, Inc. (TT) was retained by Holland & Hart, LLP (H&H) to provide forensic engineering consulting services on the Phase-I construction of the South Fork Shoshone River Bridge (South Fork Bridge) Project in South Fork County, Wyoming (the "Project"). The Project was designed by the Federal Highway Administration (FHWA) and bid to construction firms to build the Project in accordance with the FHWA's design. This is a design-bid-build project.

The Project is comprised of staged removal of the existing superstructure and replacement with steel plate girders and a cast-in-place concrete deck. The scope of Phase-1 of this Project included replacement of half width of the existing superstructure (deck and precast T-girders) while maintaining one-way traffic on the other half of the superstructure. During the placement of the deck on the two erected steel plate girders, a lateral displacement and deformation of the girder system was noted. This memo summarizes TT's review of Project documentation and TT's analysis results pertaining to the lateral displacement and deformation of the twin-girder system.

1.0 Document Review and Exhibits

In preparation of this memo, TT reviewed the following Project documents along with industry standards and published literature to assist with the analysis.

Table 1: Reviewed Documents

Date	Document Title	Designer/Author	Bates
01/24/2020	South Fork Road – Phase 1 Bridge Girder Response	Shane Nelson (FirstMark Construction)	FMC002456-2459
01/14/2020	Girder Erection Plan – 2nd Returned for Corrections	Micah J. Leadford (FHWA)	FMC000292-293
01/07/2020	Engineering Analysis of Steel Girder Deformation	Shane Nelson (FirstMark Construction) / Grutsch, T. (SMG Engineers)	FMC002468-2482
01/07/2020	Girder Erection Plan Resubmittal (Revised with comments)	Jeremy L. Ballard (Adams & Smith, Inc.)	FMC000318-346

01/06/2020	Phase-1 Erection Plan (Returned for corrections on 01/13/2020)	Jeremy L. Ballard (Adams & Smith, Inc.)	FMC000415-416
12/17/2019	Girder Erection Plan – Returned for Corrections	Paul A. Escamilla (FHWA)	FMC000265-282
11/21/2019	Girder Erection Plan - submittal	Jeremy L. Ballard (Adams & Smith, Inc.)	FMC004959-4971
10/28/2019 through 1/30/2020	Multiple Bridge Surveys	Unknown	FMC002569-2572
10/22/2019	Approved Bridge Deck Formwork Submittal (MC 1905 – 066)	Grant D. Neuharth (FHWA)	MC-000025033-25064
Oct-2018	South Fork Shoshone River Bridge – Design Calculations	Steve Belcher & Danielle Germani (FHWA)	FHWA000099-332 and PC009494-9510? [just 9506?]
8/1/2018	Stage – 2 Girder Constructability Calculations	D. Germani (FHWA)	FHWA000099 @ FHWA000194-220
10/2018 Multiple Unknown	Girder surveys – multiple dates South Fork Shoshone River Bridge – Design Calculations	Unknown Steve Belcher & Danielle Germani (FHWA)	Contained in FHWA000099-332 and PC009494-9510??
	FP-14 Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects	FHWA	FHWA001567-2328

2.0 Time History of Girder Construction

July 22, 2019 Bridge Deck Formwork Submittal – FirstMark & MCC submitted to FHWA

October 12, 2019 Phase I girders were erected by FirstMark including permanent cross bracing

October 22, 2019 Bridge Deck Formwork Submittal was approved by FHWA

October 28, 2019 Survey was performed on the girders by FirstMark – no lateral deformation noted, all girders were parallel and centered on bearings.

November 12, 2019	Bridge Deck was poured until 11/19/19 – bridge deck formwork was installed per the approved submittal and followed pour sequence per contract documents, Drawing No. RG3141-S.
November 20, 2019	Girder Deformation was reported
November 21, 2019	Girder Erection Plan Submitted by FirstMark to MCC
November 22, 2019	Survey was performed on the girders
December 17, 2019	Received FHWA comments on Girder Erection Plan
December 23, 2019	Smith Monroe Gray Engineers submitted calculations to FirstMark that showed inadequacy in permanent design
January 7, 2020	FirstMark submitted response to comments on Girder Erection Plan
January 14, 2020	Received FHWA comments on FirstMark responses to FHWA comments on Girder Erection Plan
January 20, 2020	FirstMark removed concrete deck until 1/27/2020
March 2020	MCC Proposed Plan for Straightening and Temporary Lateral Bracing

3.0 Twin-Girder System Analysis

The replacement bridge comprised of four (4) identical, straight steel plate girders spaced at 8'-2" on center and each 149'-0" long spanning 144'-0" between the abutments. The girders are connected with cross-frames at each abutment and spaced intermittently at 24'-0" on center. All the cross-frames were installed prior to the concrete deck pour. Each girder has three (3) cross-sections along its length with the first and third cross sections being identical and each spanning 29'-0" from either ends along the span. The capacity of the twin-girder system in place during the Phase-1 construction and the behavior under the anticipated loads during the concrete pour were the objectives of the multiple analyses performed by TT. Simply supported condition of the twin-girder system is assumed in evaluating the elastic buckling capacity. A simply supported girder is one which has a hinged support at one end and a roller support at the other end allowing it to move horizontally along the length of the girder. Where possible, lateral restraints were applied only at the abutments and an unbraced length of the system was 144'-0". No imperfection in the model was considered since the analysis was to evaluate the elastic buckling capacity through linear analysis. To evaluate the demands, the self-weight of the steel girders along with the wet weight of the concrete and an additional 0.1 kip/ft of load for miscellaneous loading was considered. The flexural moment from this loading was evaluated using a simply supported beam assumption.

3.1 AASHTO LRFD Design Check

AASHTO LRFD[1] is the design standard (D.S.) for the Project and Section 6.10.3.4.2 of the standard is the design provision pertaining to the desired behavior in the global system buckling limit state. AASHTO proposes Equation 6.10.3.4.2-1 for the capacity of the system in the limit state and requires that the factored demand is less than 70% of the evaluated capacity for the system to be constructed without additional measures to limit the displacement to owner-approved tolerances. In evaluating the capacity according to Equation 6.10.3.4.2-1, the length-weighted average section properties were used in accordance with the commentary of AASHTO.

3.2 Research Literature Check

The commentary for Section 6.10.3.4.2 of the AASHTO LRFD suggests that the equation was developed in accordance with the research published in the literature[2]. TT reviewed the literature and determined that the included equation in the AASHTO was a simplification of a more involved equation that would result in increased capacity. To evaluate the behavior identified in the research, TT also used the more involved equation identified in the literature to determine the capacity.

3.3 UT Bridge Check

UT Bridge[3] is a software program developed by the University of Texas at Austin to perform the erection and concrete pour analysis of straight or horizontally curved I-girder bridges. The program is used extensively by the Texas Department of Transportation and is a referenced tool in the FHWA education on stability of steel bridge construction[4]. This program enables the incorporation of the exact characteristics of the cross-frames and stiffeners that could not be implemented in the above-described methods.

3.4 TT Modeling Check

Finally, TT analyzed the girder system using a commercial finite element analysis program, SAPV2000. The system was modeled and an elastic buckling analysis was performed to estimate the buckling capacity of the system.

4.0 Analysis Results and Discussion

Table 2 summarizes the results from various analyses described in Sections 3.1 through 3.4 above. The analysis performed by SMG Engineers (from the referenced project document) was also included for comparison. The demand column represents the maximum flexural moment from the loads on the system as a whole. The capacity represents the maximum flexural moment at which the system is expected to buckle or fail. The "Demand/Capacity" column presents the ratio of the two previous columns (the

[1] AASHTO (2017), *AASHTO LRFD Bridge Design Specifications*, American Association of State Highway and Transportation Officials, Washington, DC

[2] Yura, J., Helwig, T., Herman, R., & Zhou, C. (2008). Global lateral buckling of I-shaped girder systems. Journal of structural engineering, 134(9), 1487-1494.

[3] https://www.txdot.gov/inside-txdot/division/information-technology/engineering-software.html

[4] Garlich, M. J., Pechillo, T. H., Schneider, J. M., Helwig, T., O'Toole, M. A., Kaderbek, S. L. C., & Ashton, J. (2015). Engineering for Structural Stability in Bridge Construction (No. FHWA-NHI-15-044). United States. Federal Highway Administration. Office of Bridge Technology.

unfactored demand and the unfactored capacity). The column "1.4D/0.7C" represents the AASHTO check discussed in Section 3.1 above.

Table 2: Summary of Analysis Results on the System Buckling Capacity

Analysis	Demand (kip-ft)	Capacity (kip-ft)	Demand / Capacity (< 0.5)	1.4D/0.7C
AASHTO LRFD	5039	5926	0.85	1.70
Yura (2008)	5039	5996	0.84	1.68
SMG analysis	5461	6704	0.81	1.63
UT Bridge	5039	6453	0.78	1.56
SAP	5039	7085	0.71	1.42

As evidenced in Table 2 above, the values from various analyses are consistent and the variation among the elastic buckling results is less than 10%. The results indicate that the demand on the system was less than the elastic buckling capacity of the system but considering how close the "Demand/Capacity" is to 1.0, the lateral displacements of the system are expected to be higher. A buckled system (Demand / Capacity = 1.0) would result in a catastrophic failure. However, even when stable (*i.e.* Demand / Capacity < 1.0), as the demand reaches the buckling limit, the lateral displacements are amplified. This behavior is illustrated in Figure 1 below.

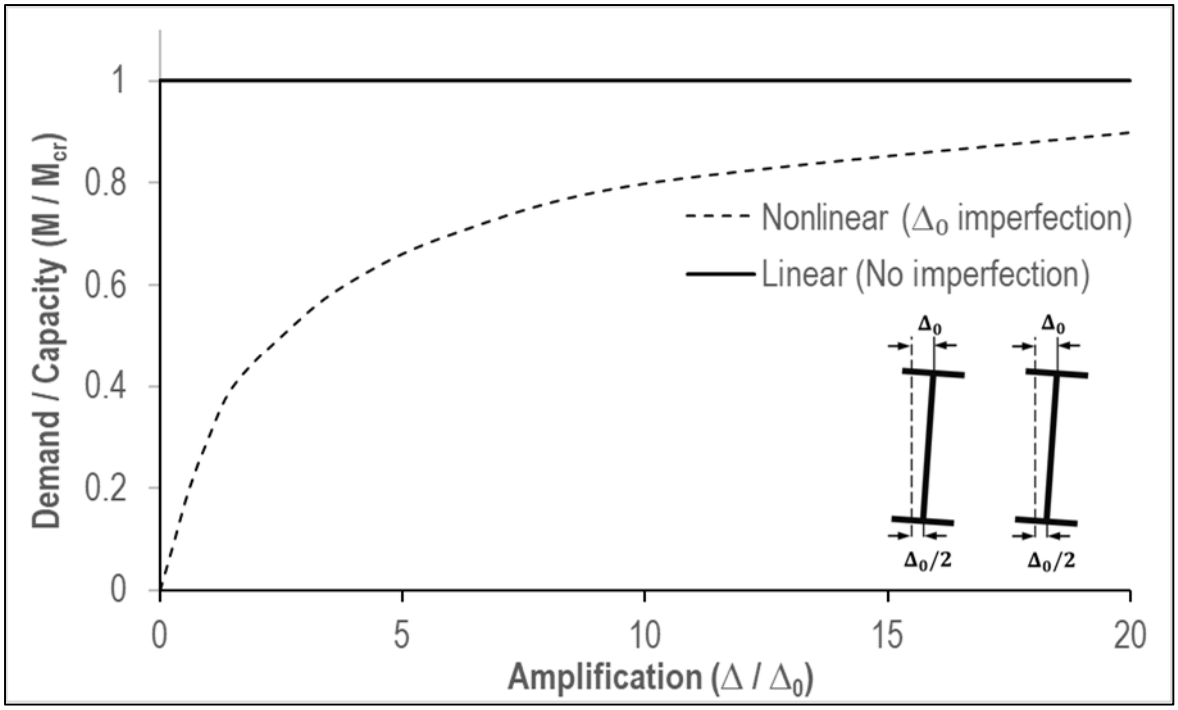

Figure 1: Schematic of pre-buckling amplification of lateral displacement of a simply supported girder adopted from actual data in (Helwig, 2020)[5] for the type of imperfection at mid-span of both girders shown in the image.

[5] Han, L., & Helwig, T. A. (2020). Elastic Global Lateral-Torsional Buckling of Straight I-Shaped Girder Systems. Journal of Structural Engineering, 146(4), 04020043.

The evaluated capacity is theoretical and considers that the members are straight and perfect. A detailed model considering the pre-pour survey information and additional assumptions (locked stresses from welding etc.) can be used to perform a nonlinear buckling analysis to verify if the displacement is the same as observed in the field. In reality, most members have minor imperfection (Δ_0), which prevent from reaching this theoretical capacity. As the demand gets closer to this theoretical buckling, the response is amplified multifold – see Figure 1. From a design perspective, the amplification of lateral displacements due to this behavior is intended to be limited to 2.0 as indicated in the AASHTO commentary for the provision. The commentary reads,

> *The recommendations in this Article are intended to avoid excessive amplification of the lateral and vertical displacements of narrow straight I-girder bridge units during the deck placement operation before the concrete deck has hardened. The global buckling mode in this case refers to buckling of the bridge unit as a structural unit, and not buckling of the girders between intermediate braces. Limiting the sum of the largest total factored girder moments across the width of the unit within the span under consideration to 70 percent of the elastic global buckling resistance of the span acting as a system theoretically limits the amplification under the corresponding nominal loads to a maximum value of approximately 2.0.*

Hence, even though the demands are less than the theoretical elastic buckling capacity, exceeding the code prescribed ratio of 0.5 (= 0.7/1.4) during the concrete pour without adequate consideration of the nonlinear displacement is a safety hazard, creating the substantial likelihood of buckling/deformation of the girder and unintended lateral displacements. This limit state was thus included in the design standard (AASHTO LRFD) to mitigate the risk. Even though this provision does not apply to the final structure, it needs to be considered by the Structural Engineer of Record (SEOR) as it pertains to constructability. Failure to do so constitutes a violation of the SEOR's professional standard of care. In other words, conformance with the constructability provisions within the AASHTO LRFD design standard is the SEOR's professional responsibility. Review of the constructability calculations for the Project demonstrate that this required check was not performed by the SEOR. This AASHTO check would have shown that the system will experience deformations and should have prompted the SEOR to require bracing measures.

5.0 Discussions and Conclusion

On October 12, 2019, FirstMark successfully erected the Phase-I steel girders together with the permanent cross bracing between the girders. The survey performed on October 29, 2019 did not show lateral distortion on the girders.

FirstMark complied with Specification FP-14 Section 562.03 – Temporary Works. On July 22, 2019, FirstMark submitted the Bridge Deck Formwork submittal to Mountain Construction. FHWA approved this submittal on October 22, 2019. As shown in the submittal, FirstMark planned on installing the formwork on the two girders complete with the permanent cross bracing between the girders.

With the permanent cross bracing installed between the girders prior to pouring the concrete deck, a sufficient superstructure design would not have required additional temporary bracing in addition to the permanent cross bracing and the bridge deck formwork. FirstMark bid on this project with the understanding that the permanent design was completed in accordance with the AASHTO LRFD design

standard. FirstMark was entitled to rely on the adequacy of FHWA's permanent design in performing its scope of work on the Project.

Analysis of the system capacity in the system buckling limit state using various methods reveal that the AASHTO LRFD code provision is reasonable and conservative to limit unintended lateral displacements. AASHTO LRFD design standard requires that the sum of total factored flexural moment should not exceed 70% of the elastic global buckling capacity determined by the equation within the standard. If the demand is expected to exceed the capacity, additional measures are warranted to limit the lateral displacement and distortion of the system.

Our review of the Project documents and calculations reveal that the SEOR failed to check this provision during the design of the bridge, despite being prescribed in the AASHTO LRFD design standard. This omission during design fell below the SEOR's professional standard of care and precluded identifying this mode of instability during deck placement. Ultimately, the SEOR's omission caused the observed lateral distortion and girder deformation.

We understand that in March 2020, the bridge deck was constructed by MCC successfully with the assistance of additional temporary bracing in addition to the permanent cross bracing and the bridge deck formwork. However, this temporary bracing became necessary due to the girder deformation that already occurred as a result of the SEOR's omission. As noted above, if the SEOR completed the permanent design in accordance with the AASHTO LRFD design standard, then such temporary bracing would not have been necessary in addition to the permanent cross bracing and the bridge deck formwork.

6.0 Witness Qualifications

See attached CVs.

7.0 Statement of Compensation

Liling Cao – hourly at $450/hour

Leo Fernandez - hourly at $380/hour

Nezar Abraham – hourly at $340/hour

Thornton Tomasetti

Leo A. Fernandez, P.E., PMP, DBIA

Associate Principal

Summary

With 23 years of structural engineering and project management experience in inspection, analysis, rehabilitation and design of roadway, railroad bridges and transit facilities, Mr. Fernandez has successfully completed projects in both traditional and alternative project delivery. His invaluable knowledge and technical skills assure that his projects are completed to the highest standards, on time and within budget as well as in compliance with current codes and standards.

Education

- B.S., Civil Engineering, 1997, University of Virginia

Registrations

- Licensed Professional Engineer in New York: 079430
- Certified Professional - Design Build Institute of America
- Project Management Professional - Project Management Institute

Professional Activities

- Member, American Society of Civil Engineers

Awards

- 2010 ACEC Platinum Award, LIRR - Replacement of Hog Island Channel and Powell Creek Bridges
- 2016 ACEC Diamond Award, Rehabilitation of the High Bridge over the Harlem River

Publications

- Comparison of AASHTO Bridge Load Rating Methods. *ASCE/SEI Structures Congress*, 2009.
- Rehabilitation of Masonry Arch Bridges, *ASCE/SEI Structures Congress*, 2010.
- Replacement of the Hog Island and Powell Creek Bridges. *Modern Techniques in Bridge Engineering, NYC Bridge Conference*, 2011.
- Building a Bridge Within a Bridge - Replacement of the Hog Island and Powell Creek Bridges. *AREMA Annual Conference & Exposition*, 2012.

Select Project Experience

Confidential Infrastructure Project Mediation, Lansing, MI. Expert witness for a mediation case on an infrastructure project in Michigan

Confidential Large Infrastructure Project Investigation, New York, NY. Project Manager for the forensic investigation on a large infrastructure project in New York.

Mill Basin Drawbridge, New York, NY*.Project Engineer for the design/build replacement of the bascule span deck of the Mill Basin Bridge on the Belt Parkway in 2006 teamed with Kiewit. Work involved 100% hands-on inspection of the superstructure and fender system to determine existing conditions. Prepared design details for replacement of the steel grid deck, sidewalk, sidewalk hatchway, timber fender system with walkway and details for stringer repairs. Responsible for preparation of contract drawings, cost estimates, reviewing RFIs and shop drawings.

Design and Construction of the Clifton Shop, New York, NY*. Project Manager for the 2-step Best Value procurement phase to replace the existing Clifton Shop at Staten Island for NYCT Staten Island Railway. Assisted in forming the team which included Prismatic Development Corporation as the GC. Presented the project to the risk management committee and coordinated with the GC in understanding the project scope of work and developing a teaming agreement. Collaborated with the GC through the 2-step Best Value procurement process helping prepare the RFQ package, respond to client questions, prepare the RFP package and assist in presentations leading up to the project win.

Rehabilitation of High Bridge, Manhattan and the Bronx, NY. Project Manager and Project Engineer for the rehabilitation of the historic High Bridge in the Bronx. The project scope includes structural rehabilitation of the oldest extant bridge in NYC to safely carry pedestrians and to architecturally enhance the bridge with lighting and rest areas for enjoyment by the public. Responsibilities include in-depth inspection of the bridge using industrial rope access and free climbing, preparation of plans, specifications and cost estimates in accordance with NYSDOT and NYCDOT standards. Provided construction support services reviewing RFIs, shop drawings and performing field visits.

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Sunnyside Yard Master Plan, Queens, NY. Project Manager for structural engineering, transportation, protective design, resilience and sustainability master planning consulting services for the development of the 180-acre rail yard that serves Amtrak, Long Island Rail Road and New Jersey Transit. The project considered erecting a platform over as much as 80 percent of the active rail yard to support the development of up to 24,000 residential units, 19 schools and 52 acres of public space. Project scope of work included overbuild structural analysis using REVIT 3D modeling, transportation consulting to address railroad structural requirements, threat analysis and vulnerability assessment, resilience analysis of site for relevant shocks and stresses and anticipated future changes, carbon neutrality consulting, passive design analytics, and precedent analysis. These services were provided as a sub-consultant to the architect for the NYC Economic Development Corporation and Amtrak.

Boston Road Bridge, Bronx, NY (NYCDOT). Project Manager for the ongoing scoping phase of the rehabilitation of Boston Road Bridge over the Hutchinson River in the Bronx. The project scope includes an in-depth inspection, survey, environmental assessment, concrete coring, traffic analysis and load rating of the existing bridge. Responsibilities include coordination with NYCDOT, technical staff and subconsultants to complete the different tasks in conformance to the scope of work, schedule and budget.

Grand Central Terminal Leak Remediation, New York, NY*. Project Manager and Project Engineer. The project involved the resurfacing of the Park Avenue Viaduct around the terminal including the 45th street bridges and Vanderbilt Avenue to install waterproofing, replace expansion joints, repair drainage structures, rehabilitate architectural cast iron cladding and update sidewalks and signals to current standards. Work involved inspection of existing conditions and verification of structural details in the field. Challenges encountered during the design phase include coordination with all stakeholders, adjacent building owners, retail spaces that will be affected during construction. The project is a joint effort between Metro North and NYCDOT. Prepared plans and construction specifications conforming to Metro North standards.

Henry Hudson Bridge Structural Steel Repairs, New York, NY*. Project Manager and Project Engineer for the Structural Rehabilitation of the Henry Hudson Bridge. Work involved inspection of existing conditions of the steel truss and concrete substructure. Prepared steel repair details which include gusset plate reinforcement/replacement and truss chord/member replacement. Analyzed the existing structure for stability during construction and provided repair alternatives to MTA for the concrete deterioration (ASR) at the skewbacks and concrete piers. Also prepared cost estimates and specifications in CSI format. Provided construction support services reviewing RFIs, shop drawings and performing field visits.

George Washington Bridge, NJ Approach Bridges, Fort Lee, NJ*. Project Manager and Project Engineer. Priority and Routine Repairs. Work involved 100% hands-on inspection of the superstructure and substructure at Lemoine and Center Avenue, and PIP bridges to verify all priority and routine repair items noted on the previous inspection report. Prepared design details for concrete deck and pier spall repairs as well as steel repairs for deteriorated stringers. Responsible for preparation of contract drawings, cost estimates and also provided construction support services.

Cordell Hull Bridge over Cumberland River, Carthage, TN*. Project Engineer. The bridge is comprised of 6 steel deck truss spans, 3 continuous steel truss spans and 5 concrete approach spans, all simply supported by concrete piers. Performed in-depth inspection and prepared comprehensive inspection and rehabilitation report for complete deck replacement, miscellaneous steel repairs (gusset plate repairs), expansion bearing replacement and concrete pier modification. Developed contract drawings, specifications and cost estimates for the rehabilitation of the existing bridge.

Verrazano Narrows Bridge, New York, NY*. Project Engineer for rehabilitation of the maintenance platform runway rails at Verrazano Narrows Bridge. Performed analysis of existing conditions and designed repair/replacement schemes. Developed contract drawings and prepared quantity and cost estimates.

Verrazano Narrows Bridge, New York, NY*. Project engineer for the miscellaneous steel repairs at the Verrazano Narrows Bridge. Developed repair details for all yellow flags issued in 2006 and 2007. Coordinated new contract drawings with existing drawings under contracts VNM-343 and VN-28. Prepared contract documents, specifications, quantity and cost estimates. Updated VNM-343 and VN-28 contract documents and submitted one complete contract set.

Outerbridge Crossing, NY Abutment, New York, NY*. Project Engineer for concrete repairs at the New York abutment of the Outerbridge Crossing. Performed field investigation to measure the extent of concrete deterioration at columns and capbeams inside the New York abutment. Prepared contract drawings to show areas of deterioration in plan and elevation. All submittals were in accordance with PANYNJ standards.

Henry Hudson Bridge, New York, NY*. Project Engineer for rehabilitation of rock slopes and rock retaining walls at the Henry Hudson Bridge approach roadways. Work involved designing temporary shielding for existing utilities, recommendation and layout of wire mesh slope protection for 1500 ft. long rock slope and designing new rock retaining walls to replace existing deteriorated walls. Made field visits to investigate existing conditions and provided design calculations, cost estimates, specifications and contract drawings using Microstation.

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Walnut Street Bridge, Chattanooga, TN*. Inspection Team Leader and Project Engineer for the Biennial Inspection of the Walnut Street Bridge in Chattanooga, Tennessee. Work involved 100% hands-on inspection of all structural elements using high lifts and free climbing. Prepared biennial inspection report and rehabilitation plans for deck replacement at north viaduct and miscellaneous steel repairs and generated quantity and cost estimates.

Throgs Neck Bridge, New York, NY*. Inspection Team Leader for the 2003 Biennial Inspection of the Throgs Neck Bridge. Work involved 100% hands-on inspection of all structural elements using UBIUs, high-lifts and free climbing, as well as preparation of Flag Reports, Biennial Inspection Report and updating Steel and Concrete Vulnerability Assessments.

Tappan Zee Bridge, Tarrytown, NY*. Inspection Team Leader for the 2002 Biennial and In-Depth Inspection of the Tappan Zee Bridge. Work involved 100% hands-on inspection of all structural elements using UBIUs, high-lifts, barges, free climbing, and the bridge traveler platform, as well as preparation of NYSDOT Biennial Inspection and In-Depth Inspection Reports. Also a project engineer for load rating and retrofit studies for the 3-mile long Tappan Zee Bridge structure. Load ratings included analysis of the thru-truss span bridge for AASHTO and Permit loads and establishing an automated load capacity database for all members of the trusses and floor framing members.

I-95 over Throgs Neck Expressway, Queens, NY*. Project Engineer for preliminary and final design project to replace existing I-95 bridge over Throgs Neck Expressway with two-span curved steel girder structure. Work involved condition inspection and load rating analysis of existing structure, updated existing design features to meet current standards and supervised junior engineers and subconsultants in preparing contract plans, specifications and estimates.

11th Avenue Viaduct over LIRR West Side Yard, New York, NY*. Assistant Team Leader for condition inspection and rehabilitation of 8-span steel girder viaduct over the Long Island Railroad West Side Yard. Work involved condition inspection and load rating analysis of existing structure as well as preparation of inspection report.

West 38th Street Bridge over Amtrak, New York, NY*. Project Engineer for seismic evaluation of existing structure. Calculated stresses based on six seismic load cases using STAAD finite element software. Calculated capacity of bolted connections and compared them with seismic stresses generated by the model.

Brooklyn Queens Expressway Connector Ramp to Williamsburg Bridge, Brooklyn, NY*. Project Engineer for construction support services. Work included reviewing shop drawings, catalog cuts and RFIs for fast track project to replace existing steel structure with concrete segmental spans. Developed contract filing system and maintained contract submittal log using Primavera Expedition.

Williamsburg Bridge Rehabilitation (Contract 6), Brooklyn, NY*. Contract 6 of the Williamsburg Bridge involved the rehabilitation of the Transit Structure along the center of the bridge. Project Engineer responsible for reviewing shop drawings, catalog cuts and RFI's for transit structure rehabilitation under supervision of senior engineer.

Williamsburg Bridge Rehabilitation (Contract 7), Brooklyn, NY*. Assistant Team Leader for condition inspection and rehabilitation of North Inner Roadway Floorbeams. Work involved condition inspection and preparation of repair details. Also prepared quantity estimates for final contract documents.

Park Avenue Viaduct, New York, NY*. Project Engineer for the rehabilitation of the Park Avenue Viaduct carrying the Metro North Railroad in New York City, Borough of Manhattan. Responsible for reviewing shop drawings, catalog cuts and RFI's for railroad structure rehabilitation under supervision of senior engineer.

Bombardier Transportation - Airtrain, JFK International Airport, Queens, New York*. Project Manager for the miscellaneous engineering services for Bombardier Transportation at JFK International Airport. Provided structural design services to address the priority and safety items noted on previous inspection reports. Prepared repair details for cracks and spalls on the concrete guideway. Also assisted Bombardier in monitoring movement at the retaining walls at Howard Beach Section that show settlement. Coordinated with Bombardier, Port Authority of New York & New Jersey and the Stantec team in performing field investigation, assessment and submission of deliverables.

Newark Airport, Airtrain Guideway Structure Inspection (Rail Link), Newark, NJ*. Quality Control Engineer for the 2014 condition survey of the Airtrain Guideway Structure at Newark Liberty International Airport (Rail Link). The Rail Link was an extension built in 2002 connecting the Airtrain base section at the Newark airport to NJ Transit's Northeast Corridor Line. The purpose of the inspection was to identify conditions that would compromise the structural integrity of the system and to determine the overall condition of the structure. Performed oversight of inspection team and reviewed Port Authority Condition Survey Report prepared after the inspection, which presented a comprehensive evaluation of the inspection findings and existing condition of the guideway structure.

JFK and EWR Airtrain Guideway Structures, New York, NY*. Project Manager for the annual walk-through inspection of the JFK and EWR Airtrain Guideway Structures. The work involved a visual inspection of the entire system from the ground and on top of deck to verify previous priority, safety and routine repairs and to document new findings.

Leo A. Fernandez, P.E., PMP, DBIA
Associate Principal

2013-2014 Comprehensive Inspection Program, Long Island Rail Road, New York, NY*. Quality Control Engineer for the 2013-2014 Comprehensive Inspection Program. The Long Island Rail Road required the services of a General Engineering Consultant for the purpose to perform a comprehensive structural inspection of bridges and viaducts crossing roadways, waterways and other railways, identified as "bridges"; tunnels, culverts, high tension towers, underwater structural and scour inspection, and a mechanical and electrical inspection of movable bridges. The major work elements include the comprehensive inspection, reporting and evaluation of the existing structural condition of all members of the bridge, tunnels, culverts, and high tension towers. Reviewed inspection reports, resolved/ coordinated LIRR comments and updated MAXIMO database.

Newark Airport - Airtrain Guideway Structure Inspection (Base Section), Newark, NJ*. Project Manager for the 2012 condition survey of the Airtrain Guideway Structure (Base Section) at Newark Liberty International Airport. The purpose of the inspection was to determine the overall condition of the guideway structure. The base structure is 1.9 miles long, up to 45 ft. high and consists of 302 girders. Coordinated the inspection team with the airport facility in performing 100% hands-on inspection of the guideway structure at night time. A Port Authority Condition Survey Report was prepared after the inspection, which presents a comprehensive evaluation of the inspection findings and existing condition of the guideway structure.

Rehabilitation of Hog Island and Powell Creek Bridges, New York, NY*. Project Manager and Project Engineer for the rehabilitation of Hog Island Channel Bridge, Powell Creek Bridge and Dutch Kills Creek Bridge – Construction Phase Services (CPS). The project involved replacement of old timber bridges with precast concrete box beam design using accelerated bridge construction (ABC) during off-peak/weekend outages. Reviewed contractor submittals for conformance to contract documents. Coordinated with client and contractor to resolve issues encountered in the field. Performed field visits to supervise contractor during construction. Managed contract schedule and costs to meet deliverables and milestones on time. Successfully completed the project on schedule and within budget and addressed all unforeseen conditions appropriately with consistent coordination with LIRR and the Contractor. This project received an ACEC Platinum Award in 2011.

JFK Airport - Airtrain Guideway Structure Inspection (Howard Beach), New York, NY*. Project Manager for the 2011 condition survey of the Airtrain Guideway Structure at JFK International Airport – Howard Beach Section. The purpose of the inspection was to identify conditions that would compromise the structural integrity of the system and to determine the overall condition of the structure. Coordinated the team, subcontractors and subconsultants. Team used high-lifts and performed free climbing to inspect all structural elements. A Port Authority Condition Survey Report was prepared after the inspection, which presented a comprehensive evaluation of the inspection findings and existing condition of the guideway structure.

Newark Airport - Airtrain Guideway Structure Inspection (Rail Link), Newark, NJ*. Project Manager for the 2008 condition survey of the Airtrain Guideway Structure at Newark Liberty International Airport (Rail Link). The Rail Link was an extension built in 2002 connecting the Airtrain base section at the Newark airport to NJ Transit's Northeast Corridor Line. The purpose of the inspection was to identify conditions that would compromise the structural integrity of the system and to determine the overall condition of the structure. Coordinated the team, subcontractors and subconsultants. Team used high-lifts and performed free climbing to inspect all structural elements. A Port Authority Condition Survey Report was prepared after the inspection, which presented a comprehensive evaluation of the inspection findings and existing condition of the guideway structure.

Newark Airport – Airtrain Guideway Structure (Base Section), Newark, NJ*. Inspection Team Leader for the 2006 condition survey of the Airtrain Guideway Structure at Newark Liberty International Airport (Base Section). The purpose of the inspection was to determine the overall condition of the guideway structure. The base structure is 1.9 miles long, up to 45 ft. high and consists of 302 girders. Work involved 100% hands-on inspection of the guideway structure at night time. Used high-lifts and performed free climbing to inspect all structural elements along the 1.9 mile long structure. A Port Authority Condition Survey Report was prepared after the inspection, which presents a comprehensive evaluation of the inspection findings and existing condition of the guideway structure. Port Authority of New York and New Jersey

Flood Repairs at St. George Interlocking, Staten Island Railway, New York City Transit, Staten Island, NY*. Project Manager for construction management services for the Flood Repairs at St. George Interlocking, Staten Island Railway. The existing interlocking area consists of 17 switches and 12 operating tracks, 10 of which are used for revenue trains. The switches include slip switches, no longer manufactured or in use on any other MTA transit property. Flooding in the entire interlocking during Superstorm Sandy (Hurricane) damaged all Signal, Traction Power, Tracks and Track equipment including cables, wires, and conduits. The work under this project includes: approximately 150' east of the East Portal of the Tunnel at the 100-115 lb rail transition to the west end of the station platforms on Track 1 through 12 and Tracks 10A, 11 and 12 through the Ballpark station up to end of Track and track NS2 (Substation). The project consists of all signal work including designing, furnishing and installation of the new CBH and Battery Hut, replacing all the tracks, ties, contact rail, bumper block and switches, cables, wires, conduits including replacing the slip switches layout with a diamond crossover etc. The VA dwarf signals will be refurbished and the incandescent bulbs replaced with light emitting diode assemblies, LEDs. The drainage system in the Terminal would also be replaced. Lubricator systems will be provided. The existing controls and indications panels in SGCC and Tower B would be modified.

Leo A. Fernandez, P.E., PMP, DBIA
Associate Principal

NYCT CM-1533 - Feasibility Study and Design for Long Term Flood Mitigation/Resiliency at Nine Stations and Adjacent Tunnels in Brooklyn and Queens, NY*. Project Manager for the Feasibility Study and Design for Long Term Flood Mitigation/Resiliency at Nine (9) Stations and Adjacent Tunnels in Brooklyn and Queens task order (#2). Responsibilities include coordination between subconsultants, coordination with NYCT, overall technical direction and day-to-day project oversight, and attending weekly meetings.

Brooklyn Queens Expressway Constructability Review, Queens, NY*. Project Engineer for the constructability review of the Rehabilitation of the Brooklyn Queens Expressway, Phase II. Responsibilities included checking contract documents for consistency and conformance to NYSDOT guidelines and verifying feasibility of proposed repairs/replacements. Subject structures included 11 bridges, 20 retaining walls and noise walls. Detailed comments for all findings and annotated plan sheets were prepared. Performed field reconnaissance to verify details shown on contract documents.

Replacement of Overhead Sign Structures, NY*. Project Engineer for the replacement of overhead sign structures within New York City. Responsibilities included review of as-built drawings of existing retaining walls. Designed special foundations for seven sign structures to be mounted on existing retaining walls. Developed contract drawings and prepared quantity estimates.

Newark Airport, Ramp Control Tower at Terminal C, Newark, NJ*. Inspection Team Leader for the baseline façade inspection of the Ramp Control Tower at Terminal C of Newark Liberty International Airport in the summer of 2006. The purpose of the inspection was to determine the overall condition of the facades and to identify any structural and non-structural deficiencies. Work involved 100% hands-on inspection of the control tower façade. Industrial rope access was used to inspect the exterior walls, windows and soffits of the control tower.

LaGuardia Airport, Central Terminal Building and Air Traffic Control Tower, New York, NY*. Inspection Team Leader for the 2005 Façade Inspection of the LaGuardia Airport Central Terminal Bldg. and 2005 Baseline Façade Inspection of the LaGuardia Airport Air Traffic Control Tower. Work involved 100% hands-on inspection of the facades at the Central Terminal Building and the Control Tower and preparation of the Port Authority Facility Condition Survey Program report for both structures. Industrial rope access was used to inspect the exterior of the control tower. High-lifts and extension ladders were used to inspect the exterior of the central terminal building.

Newark Airport, Air Traffic Control Tower, Newark, NJ*. Inspection Team Leader for the 2005 Baseline Facade Inspection of the Newark Airport Air Traffic Control Tower. Work involved 100% hands-on inspection of the facades at the base building and the control tower and preparation of the Port Authority Facility Condition Survey Program report. Industrial rope access was also used to inspect the exterior walls, windows and soffits of the control tower.

JFK Airport Terminal Bridges and Air Traffic Control Tower, New York, NY*. Inspection Team Leader for the 2004 Biennial Inspection of the JFK Airport Terminal Bridges. Work involved 100% hands-on inspection of all structural elements using high-lifts and free climbing as well as preparation of Biennial Inspection Reports and updating the Port Authority Facility Condition Survey report. Inspected air-traffic control tower structure using rope access. Industrial rope access was used to inspect the exterior walls, windows and soffits of the control tower.

Serugeme Suspended Bridge, Rwanda. Project Lead for the construction of the 285-foot long Serugeme Suspended footbridge in Rwanda in 2019. This project was a collaboration between the Thornton Tomasetti - TT Gives Back Program and Bridges to Prosperity. Responsibilities included coordination of a team of nine engineers, preparation for travel to Rwanda, handling logistics and safety, collaboration with local Bridges to Prosperity staff, performing bridge construction tasks on-site and maintaining the project schedule and budget. The bridge was completed ahead of schedule, within budget and safely. The team engaged with the local community and made a difference in their lives with the completion of this bridge. Now the community of Serugeme can cross the Mwogo all year round safely.

Thornton Tomasetti

Nezar Abraham, S.E., P.E.

Senior Associate

Summary

Nezar is a licensed structural and professional engineer with over 14 years of management and professional structural engineering experience. His structural and building envelope experience is focused on protective design, property loss consulting, failure analysis investigation, and rehabilitation of steel, concrete, masonry and timber.

He has expertise in structural dynamics, linear and non-linear finite element analysis, evaluating buildings and structures for various conditions and forms of damage, including: code compliance, construction defects, structural failure analysis, fire damage, and earthquake/hurricane/tornado/ damage.

Areas of Technical Expertise

- Forensic Structural Engineering
- Emergency Response
- Nuclear and Oil & Gas / Seismic Analysis and Protective Design

Education

- M.S. in Structural Engineering, 2008, Illinois Institute of Technology
- B.S. in Structural Engineering, 2006, Illinois Institute of Technology

Registrations

- Registered Structural Engineer (IL)
- Registered Professional Engineer (FL, IA, IL, IN, LA, ND, WY, WI, NC)

Professional Activities

- Committee Member, Structural Engineers Association of Illinois (SEAOI)
- Memer, American Society of Civil Engineers (ASCE 43)
- Member, American Institute of Steel Construction (AISC/ANSI N690)
- Participant, DOE Natural Phenomena Hazard (NPH) Meetings

Papers, Publications and Presentations

- "Material Deterioration - Fitness-For-Service Analysis and Repair of a Steel Tank," Forensic Engineering 8th Congress, Co-Author, 2018
- "Evaluation of a New Forcing Function for Analysis of Structures Due to Automobile Missile Impacts", Geotechnical and Structural Engineering Congress, Phoenix, AZ, 2016
- "Relative Building Movements for Design of Commodities in Nuclear Plants," SMIRT Conference, Manchester, UK, Co-Author, 2015
- "Development of New Forcing Function for Automobile Impact," Co-Presenter

Select Project Experience

Forensic Structural Engineering

IPFW, Indiana Pedestrian Bridge, Fort Wayne, IN. Analysis of a newly constructed pedestrian bridge for brittle fracture concerns over select welded design connection details.

Grain Bin Collapse, SKS Bunge, LaGrange, MO. Forensic investigation of a 850,000 bushel steel grain bin collapse.

Pactive, LLC Investigation, Chicago, IL. Underground water main pipe rupture investigation in a manufacturing facility.

Refinery Crane Accident, Whiting, IN.* Root cause analysis of failed steel bridge crane at BP Whiting refinery.

Refinery Failed Concrete Structure, Lake Charles, LA.* Root cause analysis of concrete tabletop structure supporting heavy vessels at CITGO and recommended repairs.

Construction Safety and Administration / OSHA Compliance

Construction Site, Chicago IL. Investigation of a steel framing collapse in a building during demolition resulting in injury of a construction worker.

Northeastern University, Chicago IL. Investigation of an overhead screen housing collapse in the recital hall resulting in a personal injury.

Confidential Construction Site, Michigan. Investigation of construction practices and contractor responsibilities involving the injuring of a concrete worker.

4th and Race Construction Consulting, Cincinnati, OH. Construction consulting of a 13 story mixed-use pre-stressed concrete building during construction.

Property Loss Consulting

Rotary International, Evanston, IL. Hail damage assessment of multiple building roofs including an 18-story tower roof, sample extraction, and recommended repairs/replacements.

Nezar Abraham, S.E., P.E.
Senior Associate

Heat Treating Plant Fire Damage Assessment, Cherry Valley, IL.* Investigation of a 70,000 SF heat treating facility to determine the extent of damage due to a fire event.

Post Disaster Evaluations, FL, IA, WI.* Structural evaluations of multiple commercial, agricultural, and residential structures in the wake of hurricanes Irma, Michael in Florida, and multiple tornadoes in Wisconsin and Iowa.

Building Damage Assessments, IL, IN, MN.* Evaluations and investigations of residential, commercial, and industrial structures for damage due to: fire, high wind, vehicular impact, mine subsidence, and construction defects. Building envelopes assessment for water infiltration.

Structural Engineering

New Nuclear Power Plant Design, South Texas Project, TX.* Structural design of reactor building, control building, radioactive waste building, ultimate heat sink building, and turbine building as part of the Advanced Boiling Water Reactor technology.

New Nuclear Power Plant Design, AP1000, GA, SC, and CHN.* Structural design of components within the reactor building containment structure as part of the pressurized water reactor technology.

Existing Nuclear Power Plant Assessments and Modifications, Multiple States. * Linear and non-linear finite element analyses of multiple systems within the plants to demonstrate structural integrity against natural and man-made hazards. Seismic upgrades of several US nuclear power plants after the Fukushima Daiichi nuclear incident in Japan.

Chemistry and Metallurgy Research Replacement Facility, NM.* Design of multiple components within the Los Alamos National Laboratory DOE facility.

SHINE, Medical Radioactive Isotopes Facility, Janesville, WI.* Design of facility against natural and man-made hazards.

Ontario Power Generating Nuclear Station, Ontario, CAN.* Design of concrete structures against tornado loadings within the new Darlington Nuclear Generating Station.

CITGO Refinery Plant Foundation Design, Lemont, IL.* Foundation design for static and rotating equipment for a new boiler unit at CITGO plant.

** Denotes work performed with previous employer.*

Contact

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